

Supplementary material for the article:

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Obtaining jute fabrics with enhanced sorption properties and “closing the loop” of their lifecycle

Aleksandra Ivanovska^{a,*}, Jelena Lađarević^b, Leposava Pavun^c, Biljana Dojčinović^d, Ilija Cvijetić^e, Dušan Mijin^b, Mirjana Kostić^b

^aUniversity of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy,
Karnegijeva 4, 11000 Belgrade, Serbia

^bUniversity of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade,
Serbia

^cUniversity of Belgrade, Faculty of Pharmacy, Vojvode Stepe 450, 11000 Belgrade, Serbia

^dUniversity of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoseva 12,
11000 Belgrade, Serbia

^eUniversity of Belgrade, Faculty of Chemistry, Studentski Trg 12-16, 11000 Belgrade, Serbia

* Corresponding author: aivanovska@tmf.bg.ac.rs, Innovation Center of the Faculty of
Technology and Metallurgy, Karnegijeva 4, 11000 Belgrade, Serbia, tel: +381 11 3303628

1. Experimental

1.1. Method used for the measurement of jute fabrics' capillarity

The jute fabrics' capillarity measurements were performed on an appliance which is presented in Fig. S1. Namely, the jute fabrics (25 cm x 2 cm in warp direction) were placed in a vertical position. Their one end was fixed with a clip on the horizontal bar, while the other end

was pre-loaded with a tag of 2 g and immersed approximately 2 cm in depth into 0.1% aqueous solution of eosin (red-colored) which level was above tag and overlapped with 0 cm at rulers printed along with the vertical plate. When the samples were immersed in eosin, the *GoPro Hero 4* camera started to take pictures at time intervals of 1 min in the first 10 min and every 5 min up to attaining capillary rise equilibrium.

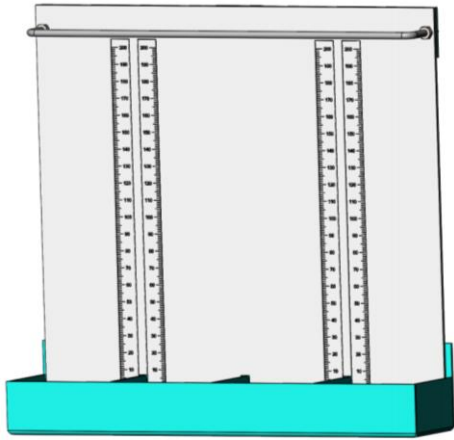


Fig. S1 Appliance used for capillary rise measurements

Based on the experimental data obtained by capillarity measurements and methodology described by Pejić et al. (2020), the three wettability parameters were determined by using Eqs. (1-4).

$$h^2 = D \cdot t \quad (1)$$

where: D (mm^2/s) is a capillary diffusion coefficient;

$$H = C \cdot t \quad (2)$$

where: C (mm/s) is a coefficient related to the mean hydrodynamic pores radius and the liquid nature, while H values were determined as:

$$H = h_{eq} \cdot \ln \frac{h_{eq}}{h_{eq}-h} - h \quad (3)$$

Coefficient R, which confirms the validity of assumption $\theta \cong \theta_{eq}$ is given by:

$$R = \frac{\cos \theta}{\cos \theta_{eq}} = \frac{D}{2 \cdot C \cdot h_{eq}} \quad (4)$$

where: θ and θ_{eq} (°) are the dynamic and static contact angles of the liquid on the solid.

2. Results

2.1. Jute fabrics' structural characteristics

Table S1 Jute fabrics' structural characteristics (The results were previously published by Ivanovska et al. 2019, 2020)

| Sample code | Fabric density, 1/dm | | Porosity, % | Crimp, % | |
|-------------|----------------------|------|-------------|----------|-------|
| | Warp | Weft | | Warp | Weft |
| RJ | 46 | 46 | 61.0 | 3.46 | 2.32 |
| JA30/1 | 50 | 52 | 52.1 | 17.26 | 12.28 |
| JA5/10 | 55 | 60 | 37.1 | 18.31 | 14.95 |
| JA5/17.5 | 63 | 67 | 29.4 | 21.15 | 20.15 |
| JA30/17.5 | 64 | 67 | 25.6 | 27.33 | 20.20 |
| JA45/17.5 | 64 | 69 | 33.6 | 21.80 | 21.07 |
| JC30 | 49 | 50 | 56.2 | 12.23 | 5.89 |
| JC60 | 50 | 51 | 57.8 | 16.75 | 7.58 |
| JC90 | 51 | 51 | 60.4 | 11.04 | 10.41 |

2.2. Jute fabrics' ATR-FTIR spectra

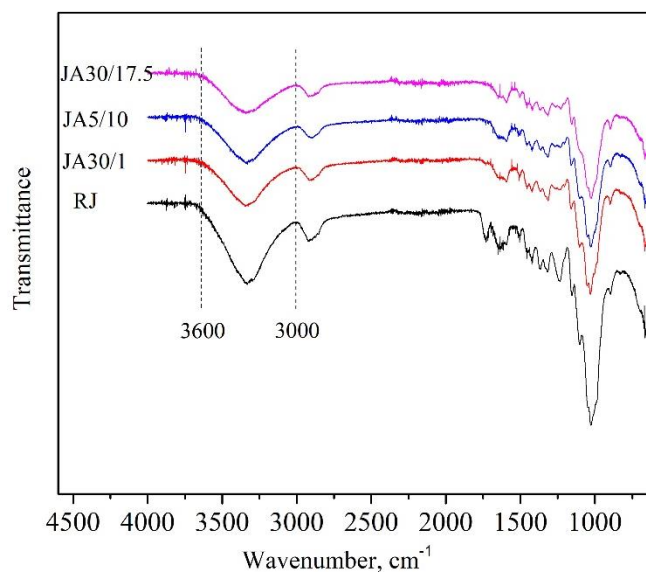


Fig. S2 ATR-FTIR spectra of raw and some alkali modified jute fabrics

2.3. Jute fabrics' capillarity

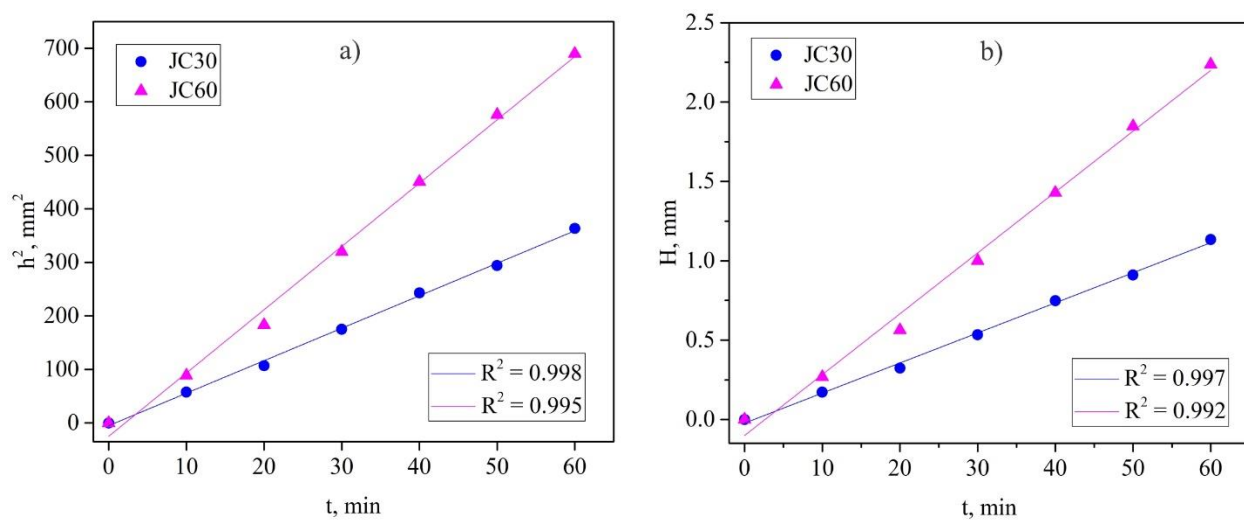


Fig. S3 Effect of oxidative modification on: a) h^2 and b) H

Table S2 Wettability coefficients D , C , and R determined from capillary rise measurements

| Sample code | D , mm ² /s | C , mm/s | R |
|-------------|--------------------------|------------|-------|
| LC30 | 6.068 | 0.019 | 0.923 |
| LC60 | 11.826 | 0.038 | 0.905 |

2.3. pK_a prediction for C. I. Acid Blue 111

The pK_a values of C. I. Acid Blue 111 were predicted using the Protonation plugin within MarvinSketch 21.4 software, a calculation module developed by ChemAxon. Predicted pK_a values are given in Fig. S4.

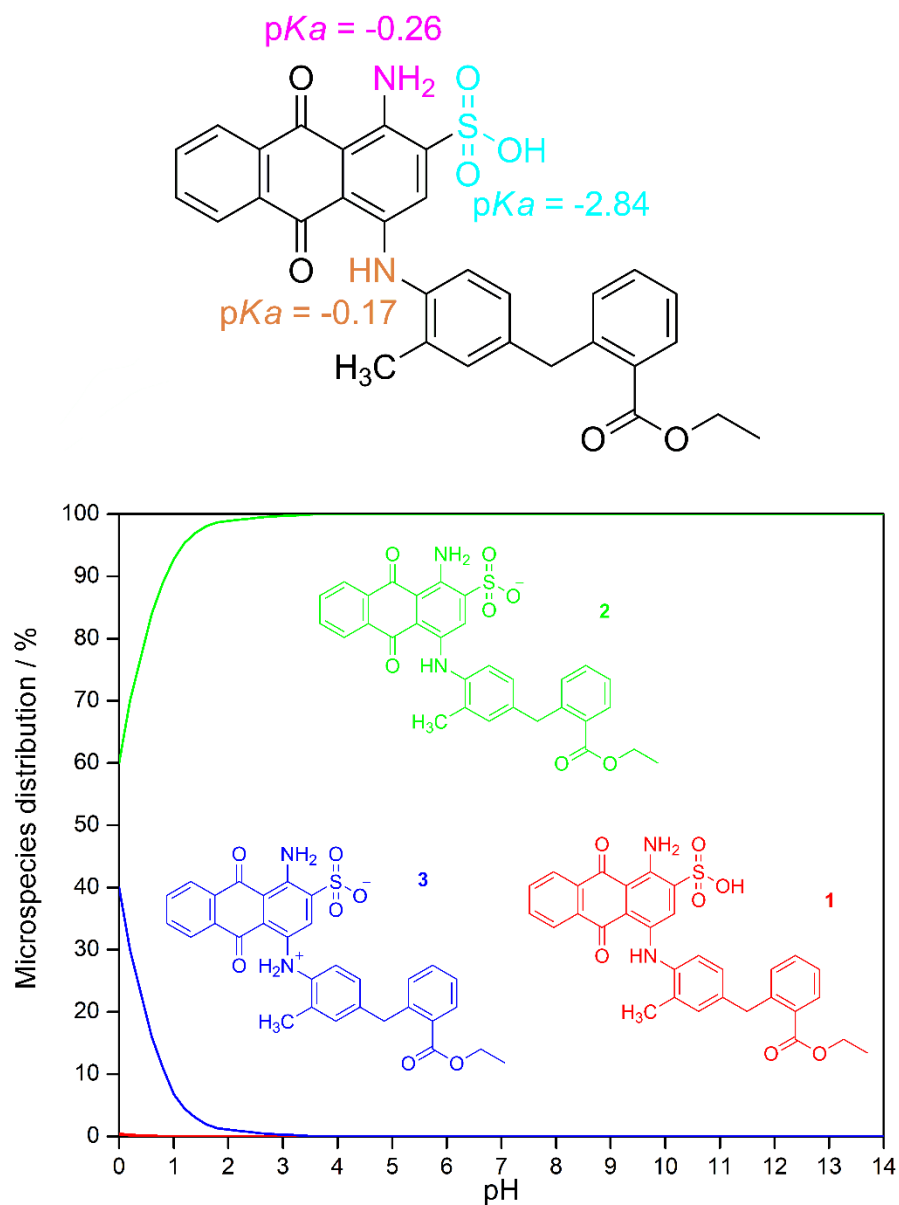


Fig. S4 Predicted pK_a values for ionizable groups of C. I. Acid Blue 111

2.4. Content of carboxyl and aldehyde groups

The carboxyl group content was determined using the calcium-acetate method (Knežević et al., 2020). The cellulose carboxyl groups react with calcium acetate (weak acid salt), forming

a salt of the cellulose and releasing an equivalent amount of the weaker acid. The cellulose should be obtained in the acidic form by replacement of its cations with hydrogen ions by the treatment of jute sample (0.5 g) with 100 mL of 0.01 M HCl solution for 1 h followed by washing with distilled water. In the next step, 50 ml of distilled water and 30 ml of 0.25 M calcium acetate were added and the mixture was stirred for 2 h. Thereafter, 30 ml portions of the liquid were titrated with 0.01 M NaOH solution, using phenolphthalein as an indicator. The quantity of carboxyl groups ($Q(\text{COOH})$, mmol/g) was calculated as follows, Eq. 5:

$$Q(\text{COOH}) = \frac{\frac{80}{30} \cdot 0.01 \cdot V(\text{NaOH})}{m} \quad (5)$$

where 0.01 is NaOH concentration, mol/l, $V(\text{NaOH})$ is the volume of NaOH solution used for titration, ml, m is the weight of absolutely dry jute fabric, g.

The content of aldehyde groups was determined according to the method described by Saito and Isogai (2004). In order to selectively oxidize the sample's aldehyde groups to carboxyl groups, 1 g of a sample was added to a mixture containing 0.905 g NaClO_2 , 10 ml of 5 M CH_3COOH solution, and 50 ml of distilled water. Oxidation was carried out by mixture stirring at room temperature for 48 h, and thereafter, the sample was thoroughly washed with distilled water and acetone. Further, the previously described calcium acetate method for determining the content of carboxyl groups was applied. The content of aldehyde groups was calculated by subtracting the content of carboxyl groups determined in the starting sample from that of chlorite oxidized one.

Table S3 Content of carboxyl (COOH) and aldehyde (CHO) groups (* The results were previously published in Ivanovska et al. 2020b)

| Sample code | Q(COOH), mmol/g | Q(CHO), mmol/g |
|-------------|-----------------|----------------|
| C* | 0.207 | 0.178 |
| A30/1* | 0.327 | 0.161 |
| A30/17.5 | 0.284 | 0.030 |
| JC30* | 0.345 | 0.020 |
| JC60* | 0.375 | 0.019 |

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